TWO SHILLINGS.

Type Composing Machines of

The Past, The Present, and The Future.

BY

JOHN SOUTHWARD

IN sending this pamphlet, the Type-Setting Syndicate, Ltd., request your attention to the description of the "THORNE" combined Type-Setting and Distributing Machine, commencing page 44, and more particularly to the appendix and specimens of work of the "Thorne" given therein.

HUGH HAMILTON.

Managing Director.

LONDON:
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Type-Composing Machines

OF

The Past, the Present, and the Future.

A PAPER

READ BEFORE THE BALLOON SOCIETY OF GREAT BRITAIN,

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BY

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The following Paper is given as it was originally written. Owing to shortness of time, some passages had to be omitted in the reading.

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Type-Setting & Distributing Machinery

Of the Past, the Present, and the Future.

THE visitor to the composing department of a printing office finds a number of operatives engaged upon a process that is, apparently, extremely monotonous and fatiguing. Standing before a pair of shallow wooden trays, known as cases, inclined desk-like, the compositor holds in his left hand what is called a composing-stick — a little iron or brass frame, one side of which is movable, so that it may be adjusted to the required width of the page or column which the workman has to set up. The "copy" from which he works rests on the least-used part of the upper case. The practised compositor takes in several words at a glance — provided the author writes an intelligible hand, which virtue is by no means universal. One by one, then, the compositor puts the letters of each word and sentence into his stick, securing each letter with the thumb of his left hand, which is, therefore continually travelling from the beginning to the end of the line. His right hand goes as by instinct to the box which he requires, but his eye is ready to accompany its movements, and to see that the types are placed in proper position. His left hand and the stick it holds follow his right hand all over the case, almost to the most distant boxes, a great saving of time being obtained by having the stick close to the lifting hand, and ready for the type to be dropped into it. When he arrives at nearly the end of the line, the type must be so treated that it exactly fills the stick — that is, is of its exact measure in width. Having seen to this, he sets, letter by letter,

another line, and so on till he has filled his stick, or set into it as many lines as it will conveniently hold. He then lifts his lines out into what is termed a galley, by grasping them with the fingers of both hands, and taking them up as if they were a solid piece of metal.

THE PROBLEM INVOLVED.

Type-setting seems, *primâ facie*, to be a simple operation. It is done by different men at very different rates—usually an ordinarily expert man will average about 1,200 to 1,500 letters, composed and justified, per hour, but he has to distribute, thereby reducing the average of work to about 1,000 per hour. It appears to be one that is pre-eminently capable of being either accelerated by mechanical aids or superseded by some more or less automatic appliance. Yet no alteration has been made in it for four centuries and a half, the apprentice of to-day learning to set up types in the exact way that the first printer worked in the middle of the fifteenth century.

Pick and click,
Goes the type in the stick,
And one by one, as the letters go,
Words are piled up, steady and slow
Steady and slow.

Why is this? In the press room department the method of the early printers has been completely revolutionised. Instead of laying on the forme, by hand, single sheets, impressing them by a plate actuated by a lever, and removing them by hand, and repeating the operation each time a sheet has to be printed, we place a web of paper at one end, arrange for its gradual unrolling, start the machine, and merely watch the paper going through the cylinders and coming out at the other end, printed, cut up, folded, and counted, without manual intervention at all. Why

has not progress been made in some analogous way in the method of type-setting?

Inventiveness Expended on the Problem.

Not because this field of invention has been neglected. On the contrary, inventors have, during the last fifty or sixty years, been almost ceaselessly designing machines for composing and distributing type, or for superseding the necessity of manipulating single types. In Great Britain alone about 150 separate inventions of the kind have been patented. In France, Sweden, Germany, and other European countries, there has been a constant succession of projects. As might be expected from such an enterprising and ingenious people as the Americans, even more of these machines have been invented across the Atlantic than amongst us. It is very probable that more money has been spent on attempts to introduce type-composing machines, than any other kind of machines known to the world of industry. One inventor after another has almost literally ruined himself in the attempt. The Librarian of the New York Typothetae, addressing the American Newspaper Publishers' Association, lately said: "We have a long array of inventors who have attempted the feat of mechanical composition, but have failed. The fortunes they have swallowed up are incalculable. It is supposed that the Alden Machine exhausted a million dollars, and it is said that a certain well-known humorist (Mark Twain) has over 100,000 dollars invested in another, his holdings, however, being only a sixth of the whole amount. Foster once assured me Foster was a man of brains and common sense, with high mechanical skill Foster once assured me that he first used up one plantation in North Carolina which belonged to him by inheritance in the experiments he had made. Then he swallowed up his wife's plantation, and afterwards (this was at the time I knew him), he was

using up a friend's. That was ten years ago, and I suppose the last of the friend's plantation is gone, for I have heard nothing of the machine since." In fact, the funds of corporations and companies have been expended almost as unremuneratively as if they had been dropped into the sea. A composing-machine is yet generally regarded as a marvel of ingenuity or a scientific toy, but not as a practical printing office appliance.

ATTITUDE OF PRINTERS.

It is sometimes said that master printers have not shown a readiness to give such machines a fair trial. I believe this to be a complete mistake. Most of the largest houses have spent considerable sums on experiments with such machines. On all hands I find a readiness to admit that machine-setting is practical and feasible. In the vaults of one well-known house there are interred the remains of nearly a score of promising composing machines—machines that were promising and nothing more. There are, indeed, several machines in use, and have been in use for some years, that are doing good and, to some extent, remunerative work. Why are there not more of them? Because their remunerativeness is not sufficient to recoup the cost of their purchase, their instalment, their cost of running. There are some other reasons which I shall have to mention later on. The broad fact is, that employers have not encouraged such machines more than they have done because the profitableness was not apparent. Their work has been done almost as cheaply and more conveniently by hand.

Besides the inventors and the purchasers, there is another class concerned in the matter—the operatives. It might be thought that the workmen are opposed to machines, and will not allow them to be used. I am glad to be able to exonerate the trade unions from such a charge. They

have never put any insurmountable obstacle in the way of the introduction of machines, provided they were worked according to trade regulations - that is, by journeymen at journeymen's wages. A resolution to this effect was passed at the meeting of delegates for all the typographical associations and societies throughout the kingdom, held in London in 1886. In the same year the Typographical Association, a federation of nearly all the local associations in Great Britain and Ireland, sanctioned a series of "rules for working type-composing machines," providing that they be exclusively operated by journeymen and duly-bound apprentice printers. More than twenty years ago, the unions adopted, although informally, the policy of not only of offering no obstruction, but of giving machines perfectly fair play. There is no class of operatives more intelligent, more far-seeing than that of compositors, and they are entirely free from those prejudices against labour-saving inventions which have led to deplorable results in some of the mechanical trades.

What Type Composition Implies.

Let us look a little further into the reason why machinery of the kind has been such a failure. One of the causes is that type-setting, though apparently a simple process, is a most complex one. It is partly mental, partly mechanical. The compositor has to decipher his copy, which in itself may take him longer than to pick up the types that reproduce it. He must punctuate his matter as he goes along, according to rule and custom. Before arriving at the end of his line he most likely will have to consider how he can make a proper division of a word which will not come in in its entirety. These are mental operations which cannot be facilitated by machinery. Besides the type-lifting process, he has to ensure that all his lines are exactly of the same length. This is of the utmost importance. It is effected by inserting or withdrawing one

or more spaces between the words. There are some four or five spaces, of fixed thickness, and these have to be combined to fill up any space that may occur between the words. The words, too, must be tolerably equally distant from one another; there must not be open gaps in one part of the line and crowding in the other, as we see even in good manuscript and type-written copies. This is called spacing out; and the object in view, the making all the lines of precisely equal length, is called justifying. Thus composing consists, amongst other things, of, 1, deciphering of copy; 2, the punctuating of it; 3, setting the types; 4, justifying the lines.

DISTRIBUTING.

After the printing or stereotyping is done, the types must be decomposed, or returned each to their proper boxes in the case. The compositor takes a handful or a small pile of lines, and holding it in an ingenious manner in his left hand, drops the letters with his right one by one into the several compartments of his case. The accuracy and celerity with which this is effected are quite astonishing; the man seems to shower the letters into the case. A clever compositor can distribute 5,000 letters per hour into their respective boxes. Here again, is a dual process the mind and the fingers curiously assist one another in the operation; for the former has to follow the order of the letters in the word by reading it, and to select the box into which each shall be dropped, while the latter has to separate one letter from another, taking care that only one letter is dropped at a time. This is called Distribution. I may mention here that while distribution is manually done at a rate of 5,000 per hour, Composition, including justification, is usually done at the rate of only about 1,000 to 1,500 per hour. In London the compositor on book-work is paid, say, 7d. per 1,000 letters, but this includes *setting, justifying, correcting,* and

distributing. The net average produce per hour of matter does not exceed as a rule 1,000 letters.

THE MACHINES OF THE PAST.

I have not time to enumerate even the outlines of the devices contained among the archives of our Patent Office of the last half century, and it would be tedious to attempt to do so. All but a very small fraction, as I have said, have been already relegated to the limbo of failure. There are, however, two or three distinct ideas pervading the whole of them which it may be useful to recall.

The unit of any piece of composition is the single letter. It has been thought that this unit might be raised by casting in one piece the whole of the letters forming very frequently-recurring words, such as *and, the,* and *of*. These letter-words have been called logotypes, and they have been favourites with many innovators. One of the most celebrated of these was John Walter, the founder of the *Times*, who, in 1782, became acquainted with the author of a book on "Logography," and in 1785 started the *Daily Register* "logographically printed." This journal subsequently became the *Times*. It was soon found necessary, however, to discard logography. It has been shown that the notion that there is any advantage whatever in the use of a system of logotypes for ordinary book or newspaper setting is altogether a fallacy, and it has been demonstrated again and again that the disadvantages encountered in the use of such combinations more than counterbalance the apparent saving of labour in being able to pick up certain whole words at one dip into the cases instead of two, three, or more dips.

Another invention for superseding the separate picking up of types was to cast a whole line. The object was to raise the unit of the page or column from the type to the line. Singularly enough, this was the first invention that

was patented in the way of type-setting appliances. The idea has been revived in the invention much advertised of late—the Linotype. The notion is seventy years old, being embodied in the specification of William Church, of 1822. He describes a plan for arranging matrices instead of setting up type and casting from them. In Charles Babbage's "Economy of Machinery and Manufactures" (3rd edition, 1832), in an account of stereotyping, we are told of a method as follows: "Instead of composing the work in movable type, it was set up in movable copper matrices, each matrix being, in fact, a piece of copper of the same size as the type, and having the impression of the latter sunk into its surface instead of projecting in relief." This is the dominant idea of the Linotype machine. It has frequently been seized upon by inventors. The reason why their inventions have been discarded is the difficulty, amounting practically to an impossibility, of getting casts of lines of matrices hurriedly put together, which shall print equal in appearance to movable type. Type-founding is an extremely delicate art, requiring the utmost nicety in its processes. Types after being cast have to be "finished," a process including planing and rubbing them. The slightest departure from alignment is fatal to good printing. Every printer knows that a good impression is not possible when there is a bit of dirt under the forme, or even a dab of paste over it. A tissue paper overlay in the wrong place will spoil good work. This is the reason why an apparatus like the Linotype is unsuitable for ordinarily good book-work.

We will now pass on to another class of machinery intended to supersede the handling of movable type. The idea is still to get a mould from which a cast can be made of the required matter. The operator manipulates a series of keys as in the type-writer, each key forcing forward a steel punch of a letter. This punch is driven into some

plastic material a piece of teak wood, damp *papier maché*, etc. The next and the next letter, each having its own steel punch, are brought seriatim into the proper position, the *papier maché*, etc., moving automatically a certain distance, whether it be a thick "m" or a thin comma. One line finished, the block is shifted, so that the first letter of the next following line will come in the right place, and the rest of the line is proceeded with, and so on until a complete page has been punched. The material is then removed and a stereo taken. This also, has been tried by many inventors. One of the first, if not the first, was John Edson Sweet, who patented an apparatus in 1866. His specification described a machine resembling in size and appearance a parlour organ, having two rows of keys in front. The type punches were mounted on the circumference of a wheel. The material whereon the impression was made consisted of several sheets of paper in a dry state. There are nearly insuperable difficulties connected with such inventions. The line cannot be so spaced as to be all of uniform length, and the irregularities of length seen in type-writing would not be tolerated in a book or a newspaper. It is impossible to calculate while punching, the exact space to be made between the words, so that the line will be precisely of the right length. Any correction subsequently discovered involves the doing of the work all over again. Above all, the cast is imperfect, some letters being stamped probably deeper than others into the material. These, when cast, will be too high, and destroy the good appearance of the whole.

Principles Pervading all Practicable Machines.

As a matter of fact, the only satisfactory surface obtainable for letterpress printing has proved to be that of composed types, and types such as are supplied by the type-

founders. The only inventions that have been practicable and feasible ones for making printing surfaces have accordingly been those for manipulating separate types and accelerating the process of assembling or composing them. Machines of this kind have always borne a strong family likeness. The types are arranged in receptacles or channels in the upper part of the machine. The operator sits in front of a key-board, having keys like those of a piano or of a cornet. When one of these is depressed, a series of links and levers release one of the types at the top of the machine, which then falls by gravity into a channel formed in a plate of such a shape that all the channels converge to the same point at the bottom. Here is fixed what corresponds to the composing-stick of the hand compositor. Succeeding types are operated upon in the same way. In some machines they are formed into a long line, which is divided into portions, equal to the width of a line in a column of a paper or a page of a book. The key-board idea pervades all inventions of the kind, with one or two notable exceptions, to which a very slight allusion may here be made.

ATTEMPTS TO DISPENSE WITH KEYS.

In 1869, Mr. Alexander Mackie, a Warrington journalist, brought out a machine the composing portion of which dispensed with the key-board. There were two appliances forming the invention the perforator and the composer. Narrow strips of paper were perforated, something like the strips which are used in automatic organs; these were placed in the composing machine, which consisted of three horizontal rings about three feet in diameter. On the top ring there were twenty pockets, each containing compartments for seven different letters and open at the bottom to allow the apparatus to extract the bottom type from any one. Over a drum, was placed the perforated paper, which

was made to travel by a positive motion of 1-10th in. each movement. There were levers and pegs always seeking to enter the perforations in the drum, but only able to enter those which had corresponding perforations in the paper. On the type being extracted, it remained on a travelling ring until it reached the delivery channel, when a pusher placed it on a travelling belt, from which it was pushed down a syphon spout, one letter after another, and arranged in a line ready to be justified. The composing power of the machine was claimed at 12,000 ens an hour. The perforating, it was said, could be done at the rate of 10,000 ens per hour, and the paper used over and over again. This would be useful for reprints and for printing two sizes of a book, as the same paper was suited for different bodies. The machine, however, did not hold its own, and is now extinct.

The Clowes Type-Composing Machine, invented in 1877, was another apparatus in which the key-board was dispensed with, and instead of it there was a range of small electro-magnets, in connection with metal contact plates. These, in size, shape, and arrangement were a copy of the ordinary lower-case. Before these contact plates, as before a desk, the compositor sat, and proceeded much as usual, only that instead of picking out the types from the boxes of his case, he touched in succession the corresponding contact plates. The touch instantly made the magnetic contact, and a letter was set free. The process of touching the contact plates was literally as swift as thought, being limited only by the rate at which the copy could be mentally spelt. The types were placed in a series of slanting troughs, standing at an angle of fifty-two degrees, each trough being appropriated to a particular letter, point, or space. At the foot of each trough, and at right angles to it, was an endless revolving carrier tape, which received the type when discharged from the trough, and passed it on to another

tape running in a transverse direction. This transverse tape received the several types in succession and carried them forward in their proper order to a point where a collector arranged them in a continuous line, ready for justifying. The machine was extremely ingenious, and its principle deserves attention. It seems never to have been used except in the offices of Messrs. Wm. Clowes and Sons, Blackfriars, where, I believe, it is now discarded. The table and the tapes are based upon an invention of Mr. W. H. Mitchell, patented in 1853, twenty-four years previously; the employment of electricity and the means of collecting the types being Mr. Hooker's own invention.

Neither Mackie's nor Hooker's machines had a distributor; but both inventors claimed that distributing into tubes for the purpose of the machine could be done by hand at less than 1d. per 1,000 by employing girl labour.

KEYBOARD SYSTEM.

The key-board system, however, has been found the most serviceable. It was originally suggested in the first specification patented in this country—that of William Church, of 1822, already mentioned. His types were to be arranged in "files" in a case at the top of the machine, each file being directly over a slit in a horizontal frame. One of a number of "jacks" -to use his own words protruded through one of those slits, each jack being connected with a key, in a manner something similar to the jacks and keys of a harpsichord. On the depression of any particular key, the upper part of its jack pushed forward the undermost type of the file into a "race," to the centre of which it was swept by collectors, so as to come under the beak of a lever, by which it was pushed down an aperture answering the purpose of a composing stick. This is the foundation on which most subsequent inventors have built.

The chief and real objection to the guide-plate principle is the limited speed. The Hattersley works at 6000 to 8000 per hour. Is that quick enough? Then the guideplates require heavier pressure upon the keys. There is also the liability of letters getting jammed in the grooves. J.S.

GUIDE-PLATE PRINCIPLE.

The important principle, which is now known as the guide-plate principle, was invented and patented just fifty years ago, in 1840, by J. H. Young and Adrien Delcambre. It is the basis of all guide-plate machines of the present day. In the middle of the framework of the machine is a horizontal bed-plate to which is attached bearings, which carry pins, forming the axes of the keys, like piano keys, to vibrate upon. Three rows of these were shown in the patent diagram. The end of the keys are connected by joints to inclined levers, on the upper part of which are fixed wedge-shaped pieces, which act against the pushing frames by which the types are forced out of their receptacles or chambers.

These chambers consist of brass bars raised one above the other, forming open channels down which the types slide freely as they are mounted in an inclined position. The grooved plate, which corresponds with what we call the guide-plate is also in an inclined position. It receives the types immediately on their being pushed out of their chambers, there being a groove to each type. As soon as each type is pushed out of its particular chamber it slides down the inclined plane and is conveyed to the setting or composing-box, serving the purpose of the ordinary composing-stick and receives the whole of the type while it is being formed into lines. Various mechanical movements are provided for the reception of the next letter in a similar manner.

Church's patent and this but especially the last contain the germs of nearly all the inventions patented for many years subsequently, namely, the key-board and the guide-plate.

Only five or six distinct machines are, as far as I am aware, at the present time practically in use in this country. About 150 have been invented. The balance may be

regarded as the failures of the past. Why have they failed? Because in actual working they have not, as already stated, been found sufficiently remunerative. In other words, their speed has not, taking into consideration unavoidable stoppages, been sufficiently high. Let us, in the light of experience, consider

THE PRINCIPAL REQUIREMENTS OF A COMPLETELY SATISFACTORY COMPOSING MACHINE.

In the first place, it must be capable of setting up type at such a speed as will by its increase over hand-work compensate for the cost of the machine, its motive power, and any slight waste, such as breakage of types, that it may entail. Probably every machine that has ever been brought out has set type much faster than the compositor could set it, at any rate for a time. Can this speed be maintained? In most machines of the past, stoppages have been so numerous that when the net product of the machine in a given period, such as a week, is reckoned up, it has been found to be not much more than if done manually. The breakdown of a machine involves loss of a percentage of capital invested in it, and very often the enforced idleness of the operator. Its results, being debited with these items, may show little or no balance in its favour. Nearly all machines that from time to time have been discarded have been found defective in maintaining a remunerative speed over a prolonged space of time.

In the next place, the machine must work correctly. Nearly all the machines at present in use set up correctly provided they have correct type to set up. In other words, the complementary machine—the distributor—must be accurate in its operations. Nearly all the machines are more or less defective in this particular. The one exception is that in which the distribution is done automatically. Seven-

eighths or nine-tenths of the mistakes found in a first proof are caused by wrong letters having been inadvertently thrown into the boxes. The compositor's hand finds its way to the proper box, but he picks out of it the wrong letter, and the result is a "mark" in the first proof. By nicking the type this source of error is completely obviated. Hence I have seen whole column galleys set up by the rotary machine to be described, with only two or three literals marked. Some composing machines require two distributing machines to feed them, and these are worked by boys or girls at a rate of about three halfpence per thousand letters. It is obvious that work thus done by unskilled labour is very apt to be badly done, and the blunders are reproduced in the proof, involving a great loss of time in corrections. Some machines set quickly, but incorrectly, and must be debited with the increased time lost in corrections.

The justifying of the line when set must be done with at least as much facility as in the ordinary composing-stick. This justifying is a point of much importance. Every line must be exactly the width or gauge decided upon there must not be a hair's breadth deviation from the "measure," as it is called. This, as has already been mentioned, is done by varying the spaces between the words. Printers have five spaces in their case the "en quad," half of the square of the body, and the width of the normal lower case "n," two of which go to the "m," which is supposed to be exactly square; the "thick" space, which is a third; the "middle," which is a fourth; and the "thin," which is a fifth of an em. There is also the hair space, but it is not of uniform size, ranging from seven to ten to the em, and ought not to be used for justifying matter. Thus we have 2, 3, 4, 5, to the em, and it is obvious that any permutation, practically, can be made with such spaces, as by spacing out or widening the line, by the substitution of a 3-to-pica

for a 5-to-pica, or by reducing the width by substituting a 5 for a 3.

In most of the composing machines justifying has been done by hand in the ordinary way—by substitution or insertion, or withdrawal of spaces. In the Kastenbein machine the matter is set in a long continuous line, and then portions about the width of the column are withdrawn and justified as usual in hand work. This is generally done by a second operator, called the justifier, who is provided for the purpose with an appliance which corresponds to the composing-stick. In the Hattersley, only enough matter is set continuously as will about make a line; when so much is composed the machine is stopped, and the matter justified before going further. Opinions differ as to the comparative advantages of the two systems. The late Mr. Hattersley claimed that the system of one operator setting and justifying his matter complete as he proceeds renders a machine most practical for the rush and hurry of daily and evening newspaper work. He held that where a second operator is necessary for justification time is lost, through the necessity of the justifier having to read, break up to measure, and justify the line, and that this inconvenience is specially felt where small "takes" are necessitated as press time approaches.

This argument seems plausible, but I do not think it bears close examination. Very short takes are not necessary when composing machines are used. If eighteen lines can be set by machine in the same time as three can by hand there is no use in giving out three-line takes. In the Thorne it is the old system of justification made easy. The types are set into a long setting-stick extending across the entire front of the machine, and there are mechanical appliances to greatly expedite the work of the justifier. In the result, justification can be done quicker than composition. I have myself seen at the rate of over 12,000

ens justified per hour. There are, on the other hand, positive advantages in having two persons to do the two distinct processes of setting and justifying. The justifier thus reads the matter after the composer, and has an opportunity of revising it and of correcting errors that may have been made. By this combined supervision extremely clean proofs are produced. The inevitable loss of time in changing from one operation to another is avoided. The attention of the composer is kept uninterruptedly to his copy. And men may set and justify alternately a man may set for half a day and then justify for half a day, as at the hand-press one man used to pull and then to roll for a certain space of time. This relieves both men, and the change of occupation is really, to some extent, a rest.

M. Lagerman has invented a machine for automatically justifying lines of irregular widths. The lines as set up by the aid of his apparatus are automatically delivered into a galley. They are not all of the same length. The galley is removed to the justifying machine, and each line is taken separately and is automatically measured, a scale showing how far it is below the standard length. The spaces between the words are then successively pushed out sideways, and are replaced by others, wide or narrow, as the case may be, until the index shows that the line is of the right length. There are three spaces available for insertion in the line, respectively 3-12ths, 4-12ths, and 6-12ths, or an en quad. By combining these, any space between 3-12ths which is the ordinary middle space to 24-12ths, or two em quads, can be obtained, and the line brought to the length required. This is done semi-automatically by the machine. The index shows all the time how the adjustment of the length is proceeding. The attendant keeps his eye on the index, and by a touch of his finger determines the size of the new spaces which are being inserted.

A view has been taken that, unless a composing machine also justifies, it is of no advantage. Obviously, if much extra time is lost in justifying, over that as ordinarily done, the gain on the setting may be of no advantage. But if the time taken up in justifying is not more than usual, there is the advantage of the setting intact. This is almost too simple to need being pointed out. There are two distinct operations ; if one is done at least as quickly as by hand, and the other, the setting, many times faster, the latter is all to the good. Besides this, absolutely automatic justification is an impossibility, because no machine will detect literals and transpositions, and as no compositor can always set perfectly accurately, the supervision of a second operator is imperative.

The Linotype had another method of justifying, and a very ingenious one. Unfortunately, it is not applicable to movable types. The collected matrices were placed between two rigid uprights to be justified. The spaces were strips of steel, about three-and-a-half inches long, about a pica thick at the lower end, and tapered to a knife-edge at the upper. They were inserted between the matrices of each word as set, the thin end remaining about flush with the tops of the matrices, when the line was pushed into place between the fixed uprights. These tapered spaces were pushed up from underneath and so widened out the line to the required length, while, at the same time, they preserved the utmost uniformity of space between the words. This uniformity was absolute, and would be impracticable in handwork. I am told, however, by a practical Linotype operator, that the machine did not always space the line automatically as is asserted ; for if a word, or part of a word, could be got into a line which was too short to allow of the "space bands" spreading it to the required length, the operator had, with his own fingers, to place thin spaces between the words. Short lines were produced

very often, some of them requiring as many as eight or nine thin spaces. Furthermore, if the operator had to centre a line, or to set signatures, addresses, etc., he had invariably to stop operating, and use his fingers to justify the line; and as the machine only supplied him with em quadrats, the ordinary compositor, with the usual box of quadrats at his disposal, could do the work in less time.

The mechanism ought to be simple and not liable to get out of order. Many machines have doubtless had to be discarded through not meeting this requirement.

It should work with as little noise or clatter as possible, in order that there may be no objection to its being operated in the ordinary case-room, and on the same footing as compositors.

It might be held that a good machine should be capable of setting several sizes of type. The Fraser claims as an advantage that five different sizes of type, from small pica to minion, can be set by one machine. Even this would not be an advantage if the change could be made without delay. All the charges for the machine—the tubes in which the letters are kept—would have to be changed and re-adjusted. This would involve a delay which would neutralise any advantage from the interchange. What would be thought of a printer who had only one case and changed the type in it whenever required? The idea is absurd, and little less so is the idea of changing the type of the machine. One machine for one size of type is the reasonable and only advantageous plan, theoretically and practically.

It should be capable of manipulating every sort, from the thick "m" to the thin "i." In the "guide-plate" machines each type is delivered into a series of channels converging to one point, causing the delivery of every letter to the same place. This system necessitates arrangements for bringing different thicknesses of letter down one channel.

These arrangements usually consist of delicate springs, which, with rough handling of any kind, will get out of order. The Kastenbein, the Fraser, and the Hattersley, are machines of the guide-plate order, and are amenable to this objection. They do manipulate various thicknesses of type, but have recourse to springs and similar contrivances liable to wear and disarrangement.

It has been held that the completely satisfactory machine should not require specially nicked type. Let me explain what this "nicking" means. The object is to get the different letters, when assembled together as words, decomposed and returned to their different channels; the a's in one, the b's in another, and so on. Now, to make the types assort themselves automatically, they are slightly nicked at the sides, and the channels are "warded." The relative conformation is like that of a key and the wards of the Chubb lock; a key that will fit one lock will not fit another. The types so nicked pass over a series of channels, and only fall into those having wards with which they correspond, but are not received by any other channel; all the a's, being nicked alike, fall into the a channel, the b's into the b channel. This ensures absolutely accurate distribution.

Several objections have been raised to the nicking expedient. The most formidable, apparently, is that it weakens the type. This objection is merely hypothetical. The strain on the type is vertical, when it is under the printing cylinder, and the type is supported on all sides by other type, the mass being practically solid. If it were subjected to a longitudinal strain the nicking might certainly render it less able to resist. If this objection were valid there would be a deal of type broken by the machine. As a matter of fact, a machine runs a whole day, setting up perhaps 80,000 letters, and the breakage is not more than a few ounces. Type of the kind, if materially weakened, would not stand the wear and tear of newspaper

stereotyping—the beating of the type to form the mould, the heating to dry it. The greater portion of some of the inside pages of an evening newspaper go through this ordeal seven, eight, or nine times a day. In the *Manchester Guardian* office, for instance, there are founts of nicked type that have been subjected to this ordeal for nearly two years, and the type hardly shows signs of wear—at any rate new additions to the fount are not distinguishable in the impression. Then it is said that the types nicked are more inconvenient to handle. But in the Thorne machine they do not require to be handled. As to the expense of so preparing it; the cost is fractional, and is recouped the first time the type is distributed. There is also to be taken into account the incontestable advantages of automatic distribution at a speed practically unlimited—from 20,000 to 30,000 per hour. There are other merely theoretical objections. One is that the accuracy of the distribution might be lost through the type growing in the process of repeated stereotyping. Experience has shown that no such results have followed years of daily use of type thus nicked.

The type must, of course, be very accurately nicked. It is done as a separate operation, after the type has been cast and finished.

The nicks are in about ninety different positions, corresponding to the conformation of the same number of wards in the distributing mechanism of the machine. The accuracy of this nicking may be appreciated when it is mentioned that there are for the types four nicks and these are varied in position so that no two of the ninety necessary sorts are identical.

The satisfactory machine ought not unduly to wear the type, especially the face. In some machines, especially those which employ the principle of gravity for emptying the type channels, the type is ejected from the groove by a

metal pusher impinging upon it. This repeated over and over again soon wears, or rounds off the face, and the life-time of the type is shortened. Indeed, in some a fount lasts only half its proper time owing to the undue wear to which it is subjected. An illustration of another wearing action will be found in the Lagerman Typotheter, to be subsequently described. In the Thorne machine, on the other hand, the face of the type is never touched by any metallic surface during the whole of its manipulation.

The satisfactory machine will require no supervision except that of its operators ; indeed, as machines come into general use, operatives will rise to their requirements, as with the other machinery of the printing office.

WHY TYPE-SETTING MACHINES HAVE NOT COME INTO MORE GENERAL USE.

Such are the principal requirements of the completely satisfactory machine. Let us now consider the chief reasons why type-setting machines have not come more generally into use. These objections may be divided into two classes : 1. Objections in general to machinery for the purpose ; 2. Specific objections to particular machines.

Some compositors, it is true, are disinclined to acquire a knowledge of machine composition. Having learned the art of composing by hand they prefer to continue to do the work in that way, and object to learn the machine. But there is no lack of intelligent men ready to adapt themselves to new conditions and to acquaint themselves with new appliances. This is more especially the case when it is understood that more than "stab" wages can be earned, and that the labour is much less exhaustive.

It is true that in some places prejudice has arisen against machine work because it has been entrusted to boys or girls

or women, at low wages. It is not unreasonable that the men should look with disfavour on this state of things. Girl operators on some machines are paid very little indeed. Why? Because they work so slowly, comparatively, their output is so limited that to make them remunerative at all, cheap labour must be resorted to. A machine producing 6,000 and upwards, however, may well be worked by skilled and duly-paid labour.

Another cause why some machines have not been more used arises out of this: their working has been entrusted to boys and girls who, apart from other disqualifications for operating delicate machinery, have not been acquainted with the rudiments of type composition or accustomed to read copy and punctuate it properly. Let me remind you that there are limitations common to all type-setting machines. Under the most favourable conditions and perfection of mechanical design the type-setting capacity is limited by the ability of the compositor to read his copy, to spell, and to punctuate it. If the machine compositor cannot read his copy and deal with it as the ordinary compositor does he cannot make the machine remunerative. What is gained in type-lifting is lost in correction if the operator is not a practical and trained compositor. Mere composition does not require long to learn, however, but it has to be learnt. Much more has to be known than is necessary for the type-writer operative. Individual machines have fallen into discredit owing to the deficiencies of the management or of the operators put to work them. I may repeat what I have already said that non-practical people often ignore the real nature of the work which they watch the manual compositor doing. He is not a mere animated machine, picking up type and arranging it in a tool. He is deciphering his copy, spelling the words for it is seldom that handwriting is so good as to distinctly indicate the different letters of a word punctuating them, and

probably just before arriving at the end of each line considering how to make a proper division of the word according to etymological rules and printing customs. This cannot possibly be done for him by any machine, however ingenious.

The price of such machines has restrained the use of them. A Hattersley composer costs £150, the two distributors necessary to work it are £100 each, so that the total expense of a single installation is £350. The Fraser is cheaper. But the question of cost really depends on the produce of the machine. This, too, is obvious. A Thorne combined type-setting and distributing machine, with quite double the output capacity, costs about the same amount of money. The manufacturers, moreover, guarantee that its cost will be recouped in eighteen months from starting work with inexperienced workmen, if it is kept fairly going by operators of average ability and application, so that in the "Thorne" there is now offered to the trade a rotary machine with producing capacity equivalent to two sets of guide plate machines, costing together about double the money, and entirely lacking automatic distribution, which is done at merely nominal cost by the Thorne.

Another cause which has retarded the more general introduction of composing machines has been their untrustworthiness. With some of them it has not been safe to depend on them to produce the work by any given time. They break down, require repairs and readjustments, and these cannot be done by the operator. Recourse must be had to a skilled mechanic, and one who has had experience of the particular machine. A machine liable to break down is most eminently unsuited to a newspaper office, where the work must be done in the most feverish condition of hurry and to time. A break-down would be almost fatal. Those who intend to purchase a composing machine ought to be well satisfied of its regularity and working over a

considerably protracted space of time. Mere exhibition or show-room performances ought to but slightly influence the purchaser. This is too often overlooked, and the result is disappointment.

For some machines the makers claim a rapidity of working that cannot possibly be sustained for a protracted period. This may be owing to one or both of two reasons. One mental, the other physical. It has often been stated—held to be proved by experience—that only in exceptional cases can one operator be found who can work the keys for a continued period at a rate of more than 5,000 per hour. The mental strain is too great for the vast majority of men. The remedy for this is the plan of alternate setting and justifying already mentioned as a distinguishing feature of the Thorne. The other cause is the heavy physical exertion. Here I must point out that all the machines of the present day are actuated by keys somewhat similar to those of a type-writer. When one of the keys is depressed the mechanism liberates a type, which in various ways is conducted to the composing-stick. This arrangement is common to all machines. But some are far more difficult and arduous to work than others. One finger of the right hand is used to depress key after key. This soon becomes tedious and irksome, and, after a short time, fatiguing. The Kastenbein machine, for example, is exceedingly hard-touching ; then the Fraser, and the lightest of this class is the Hattersley. There are mechanical causes for this difference, which I have not time to point out. In the rotary principle adopted in the Thorne this disadvantage is overcome, as the keys may not only be as lightly touched as are those of a piano, but they may be worked with both hands, thus relieving the tedium and fatigue of the single-finger apparatus. Anyone can realise how fatiguing it would be to play a musical composition with one finger, if it were possible. The analogy to the piano is carried further in the

case of the Thorne. Not only can both hands be used, but the fingers can strike several keys simultaneously, like striking a chord on the piano. Words like "and," "the," "coming," and so on, can be struck altogether. It is superfluous to point out how conducive to celerity and ease of working this arrangement must be.

I have now dealt—necessarily very superficially—with the chief requirements of a completely satisfactory machine, and with the principal causes why machines have not come more generally into use. There are, however, specific advantages and disadvantages of particular machines, and these now require dealing with. This will involve a very short outline of the construction and working of the several machines.

CLASSIFICATION.

It may be convenient to group the different machines in use at the present day according to their distinctive principles. They are the Lagerman "Typotheter," a sort of hybrid machine, retaining the use of the present printer's case, and intended to facilitate, not to supersede, hand-setting; the Hattersley, the Kastenbein, and the Fraser, which are guide-plate machines, and the Thorne which is on the rotary principle.

I had intended to refer, along with the present day machines, to the Linotype. It is not a type-setting machine—not a machine for setting up movable types—but one for arranging matrices and for casting from them line bars capable of being printed—imperfectly, however, in my judgment—on a letterpress machine. This Linotype Machine was introduced into this country about twelve months ago by a company which at first asked for a capital of one million sterling. The vendors fixed the purchase price of the patents at £820,000. About £11,000 was spent merely

in advertising the company. The machine has been tried in London, and has already been discarded.

The Chairman of the Company, Mr. Jacob Bright, at a meeting of the shareholders on the 27th August last, said: "You will remember that we had machines in a printing office in London—at Mr. Burgess's—but those machines have done absolutely nothing." This, Mr. Bright attributed to the fact that the matrices were of American origin. The Linotype Machine has been tried in other places. The result may be judged by the fact, conveyed to me by the Secretary of the Linotype Company in a letter he wrote to me about a week since: "We months ago decided to cease manufacturing it." So that it is already a machine of the past; another addition to the melancholy list of failures during the past seventy years—failures which have swallowed up such an incalculable amount of capital.

Although, nevertheless, the manufacture of the machine is discontinued, I may briefly point out why its principle is essentially mistaken and unpractical. To do so may be both useful and cautionary.

The Linotype machine had as its basis a series of small disconnected matrices of brass, each containing a mould of a letter or character. These matrices were brought together to form words, and when there was a line thus composed a cast was made of it. The key-board had one hundred and seven keys, each for a different character.

When a key was struck, a sliding plate was actuated which carried the matrices to a channel, and its passage was expedited by a blast of air directed through a tube. Followers, or metal fingers, kept pushing forward the characters, until the line was completed, or nearly so. The matrices had on their faces a replica of their casting face. The spacing was done by the space keys already mentioned. The line, being spaced, dropped in front of a pot of type-

metal, kept molten by gas-burners, and a chamber was formed round it, of which it formed one side. A force-pump, connected with the melting pot, ejected a charge of metal into this chamber, and so cast the line of type, which the matrices then left. The bottom of the line was next planed to type height, and it was pushed through a slot which trued the sides and ends. The line was ejected on to a galley to be followed by succeeding lines, as the matter was set. The matrices having done their work ascended automatically to the upper part of the machine, where they were caught by carriers and dropped into their respective tubes. To distribute the matrices they were notched or nicked.

The principle of this machine—the casting from matrices instead of using type, was, as already stated, very old. Its patents could be valid only in respect to details. Its mechanism was most ingenious. It had, however, one fundamental disadvantage, which entirely removed it from the category of machines suitable for doing first-class work. The alignment of the printing surface was often irregular. Work I have seen done by it was inferior, and would not satisfy anyone accustomed to good book printing. The best part of the machine was its justifying arrangement and its good spacing. It had other advantages. As each line was cast in one piece, making-up could be done a little faster than in ordinary, and there was no liability of letters slipping at the ends of the lines. The speed attained was said to be ordinarily about 3,000 per hour. The *primâ facie* advantage of this had to be debited by the expenditure of gas to heat the metal, depreciation of metal, and general wear and tear. In addition to these items, which must have been very considerable, there was the wages of the operator, and £80 per year, which the manufacturers charged for royalty. The wear, cost of maintenance, and the 30s. per week, probably amounted to more than the

wages of a second operator. Thus they had only about 1,250 per hour as the nett produce of an operator a saving over hand work that was so small that I cannot think it was worth while to instal such a heavy, complicated machine. I am informed by those in a position to know that there were many positive disadvantages which made themselves evident in actual experience of the working of the Linotype. It was difficult to learn. An operator who showed it lately—an expert brought over from America was first paid £10, and then £8 per week. No editor would trust solely to it for turning out a daily paper. Even experienced operators of the Linotype made more errors than the average compositor did at his work. To correct his errors, the Linotype operator had to set out and recast the entire line, with the same liability as before of committing errors ; and, in the event of words being left out, he had frequently to re-set as many as a dozen lines, or it may be the whole of the matter down to the next paragraph. As he had only thin spaces, "space-bands," and em-quadrats to work with, the spacing, when he had to over-run matter or to "make even," was often worse than that of the compositor similarly situated.

The Linotype was operated like the type-writer, only one finger of each hand being used in the manipulation of the keys, of which not more than one was depressed at a time. I am informed that it often happened that when the key of a certain letter was touched, the matrix in which the letter was stamped failed to leave the tube in which it was located, and if the operator did not read each line before it was cast, he might have gone on working without being aware of the fact that a certain letter was not acting, and may have set a dozen lines or more before discovering that the letter "a," for example, had not been forthcoming. A loss of time was of course involved in taking out the tube and readjusting the matrices, after which all the lines containing the

omission had to be reset. The matrix, when liberated, might fall into such a position that the air-blast was unable to drive it forward ; consequently all the letters following it were unable to pass, and the operator probably did not discover this until several matrices had become clogged, when it was only with great difficulty and considerable loss of time that they were set free again. The air-blast frequently blew the matrix out of the machine altogether, and the operator often spent several minutes in his search for a lost matrix.

I am also told that the distributing apparatus did not work consistently, often giving the operator the trouble of taking out a tube and examining all the matrices it contained in order to remove one which might belong to another tube. Sometimes the line of matrices got clogged with metal from the casting apparatus, in which state the line had to be taken out of the machine, and every matrix and space to be set free from the least particle of metal before it was in a condition to go back into the machine. If the metal used for casting was too hot, it squirted in all directions ; if it were too cold, it cast uneven lines ; and as it was extremely difficult and often impossible to keep the metal in a proper condition of heat, the operator lost much time in attending to the heating apparatus. Dozens of lines which were cast were indistinct, the result being that if they were not cast over again many parts of the printed matter were almost undecipherable. The operator had often to stop his machine to replenish the metal-pot and to remove the metal which had been squirted about the casting apparatus (often a matter of difficulty, and generally involving considerable loss of time). Experts on the machine said that three or four hours every week must be devoted to its cleaning or the matrices failed to act. What with stoppages, cleaning, oiling, and attending to the metal-pot and heating apparatus, the operator lost almost

as much time as the compositor spends over his distributing.

The Secretary writes me, as I have already mentioned, that the Company has abandoned manufacture of the machine, which was represented in the prospectus and advertisements of the Company to be saving at the rate of £13,000 per annum to the *New York Tribune*. The Secretary, however, tells me that the Company are about to introduce a new machine. What the principle of it will be I do not know, for the Secretary himself has not seen it, and has only heard of it. He wrote to me on the 23rd September, in these words: "The improved machine is said to be fifty per cent. faster than the present one. I have not seen it yet; but if it comes up to all we hear of it, it must be a marvellous invention."

Passing from this illusory and exploded idea of casting line bars, let us consider the machines in use, more or less particularly the latter.

The Lagerman machine is really an auxiliary to hand composition, which it aims at accelerating not attempting to supersede it. It is called the "Typotheter." The compositor is still employed to pick the types out of the case in proper sequence. But instead of arranging them in words and lines in a stick he merely drops them one after another into a hopper. He gives himself no care as to how he picks up the type; upside down or in any way it may come to hand will do, for if wrong the machine will set it right. If the type should reach the bottom of the funnel with the nick end down and out, it will be caught by a succession of fingers and cams and moved along until it joins the line previously set. If, however, it should pass into the funnel in one of the other several possible and incorrect ways, the machine will see that it reaches the end of its journey in the correct position. As the type comes into line it passes in front of the compositor, and a bell, which rings auto-

matically, warns him as each line is nearly complete, to drop in a space bar slightly higher than the type, and, thus spaced, the whole line moves along to the galley, into which it slowly slides. The galley is of metal arranged with transverse channels for the reception of the type; and the high em-space bar at the end of each line causes the galley to automatically descend and thus cut up the long line of set type into its line sections, and thus form the column. Type for this machine must have a specially-cut nick on one side. The justifying is done at a separate machine, as already stated. It is said that a man can set about 4,000 per hour. I doubt this very much. The possibility of using both hands instead of one is claimed as an advantage: I regard it as a doubtful one. The hand compositor picks out his types with the right hand, while with the left he holds his stick. He carries the latter all over the case, following closely his right hand as it approaches the boxes, wherever situated. But in the Lagerman Typotheter every letter has to be brought to the hopper in front—some letters a considerable distance. I consider that this increased distance to be covered greatly neutralises the supposed advantages of using the two hands.

As already stated, it is claimed to set from 4,000 to 5,000 ens per hour. An ordinary compositor does about 1,000 per hour. That is, he sets, justifies, and distributes that number. Now, the Typotheter only does one of these things—the picking up of the stamps—the justifying and the distribution being two distinct operations, and rendering necessary two more handlings of the type. The agent for the machine claims that it does the work of three men. So it may, as far as composition goes; but in reality, as we have to deduct the distributing and justifying, equal to half the work of composing, it only does that of one man and a half—that is, about 1,800 per hour. This must be obvious. Whether that is an adequate result from a

machine costing £170 in first outlay, I leave anyone to judge. There is a further deduction to be made, and a serious one. In distributing by hand there is the liability to drop the type into the wrong box, and the error reproduces itself in the process of composition. The man at the Typotheter does not look at his stamp as the hand compositor does. He picks it up and just throws it into the hopper. If it is wrong, it must be corrected by the justifier, necessitating a slower process on the part of the latter. The machine is delicate to the extremest degree. There is to be further regarded wear and tear of type. I put it to any printer present to realise what must be the effect on the face of types constantly being thrown into a metal hopper, turned round, twisted, and dragged along by metal "feelers." What master printer would desire his type to be subjected to such treatment? I think we may dismiss from the category of practical type-setting machines one which is so costly compared with its performance, whose performances are so meagre, and which must shorten the life of a fount of type.

We now turn to the guide-plate machines. The Hattersley, the Kastenbein, and the Fraser machines belong to this class, as already stated. We begin with the Hattersley. In this, the type, having been previously prepared for setting, is contained in the upper part of an iron framework, about three feet square and five feet high. In the lower part of this framework is the key-board, which is so arranged as to contain the keys in six rows. In front is a set of space boxes for spacing out. The previously distributed type is stored upon two iron "tables" and arranged in distinctive rows, separated from one another by brass partitions. To keep the type to the front edge of these tables each type has a metal clump behind it to which a spring band is fastened. This band runs horizontally over a portion of the type and is then brought into a frame, where it is fastened. Its elastic force, decreased as the line of type gets shorter,

is intended to keep the letters well to the front. Now, as to the transmission of the types. At the front of the table, at a point corresponding to the end of each respective channel of type, a small opening is pierced just enough to allow the type to fall through. When the passage of the letter is desired, it is effected by striking the key belonging to it, which brings down upon the letter a steel pusher, corresponding somewhat less in thickness than the letter which it strikes. The pressure from the pusher overcomes the tension of the springs, and pushes the letter through the opening below into its appropriate converging channel in the guide-plate. The pusher returns to its original position by the action of a spring. When the type has passed out of the guide-plate, it is received by the end of a horizontal lever immediately against it, and a movement sends the type or line forward by just its own thickness, so that room is made for the next letter falling after it. When the operator has his line set and has justified it to measure, he takes out the setting rule and drives the line down the galley. The justifying is done as in an ordinary composing stick, as already mentioned.

Complementary to the composing machine is the type distributing machine. There would, however, be no advantage in using it, except that its construction is such that it arranges the type in due order for the composing machine —which is the part of the invention in which the saving of time is effected. This, too, is the reason why to keep one Composer going, two Distributors are required. They are attended to by girls. The type charges from the composing machine are replaced side by side, horizontally across an inclined plane. A galley, similar to that ordinarily used in printing offices, is provided, for holding the column of matter to be distributed, and a long steel plate, to which is fixed an index bar, is situate at the end of the channels of the supply tables. At the front edge of this steel plate is placed a

double row of V toothed steel combs. When the column of matter has been slid into the galley a line is lifted or sliced off from the end of the column into an instrument which is held in the hand, called the distributing stick—practically a box capable of holding one line, and connected with mechanism by which the letters are ejected down into the supply tables. The operator having read the line contained in the stick, points it for each letter in the line to the corresponding letter indented on the index bar, and the V comb before mentioned brings the stick into exact position for the openings of the channels, while mechanism connected with the stick pushes the letter down the channel. The stick being then brought back, the pusher recovers its position, and is ready to eject the next letter. The mechanism is such that it is possible for letters of lesser thickness than the intended letter to pass into the channel, but the type is distributed into the supply tables in rows faced upwards convenient for the necessary correction. After the girl has distributed sufficient to fill the charge, and the matter is carefully revised, the charge is removed from the distributor, and is ready for placing in position on the composing machine. There is in the machine nearly the same liability to error as in hand distribution. Hence it becomes necessary to have the distributed type "revised" before transferring it to the composer. It is also trying to the eyes to be constantly reading the line in the distributing stick, which is in motion, and to be constantly looking to see that the pointer goes to the right tooth, especially as the teeth are necessarily very small.

The Kastenbein composing machine is very similar to the Hattersley, indeed, Mr. Hattersley claimed that it was an imitation of his. At one time the Kastenbein machine was in use in several offices in this country, but it seems to have maintained its position only in the *Times* office, where it has been greatly modified to suit their requirements.

During the day men are engaged preparing the type for it. A large portion of the type used for the composers is, as already mentioned, not distributed at all, being melted and recast in a machine, which produces the type set up in long lines, suitable for the composer. In the Kastenbein the types are situated at the top of the guide-plate, with the the keys below and in front. The types, however, instead of standing on their feet in the grooves of a horizontal tray, as in the Hattersley, are stored vertically over the top of the guide-plate and rest upon their nick sides, their faces being towards the operator and their feet away from him. The supply is kept up by movable tubes filled at the distributing machine. Instead of being pushed into the guide-plate they are simply withdrawn from the vertical grooves and allowed to fall by their own weight through their respective channels in the guide-plate into the receptacle or setting-stick. A push to the right gets it out of the way of the type which follows it. The receptacle or setting-stick communicates at its left hand extremity with the justifying galley. The justifier, when a second operator is working, sits at the right of the composer.

Accompanying the Kastenbein composer at the *Times* office is a distributing machine, which is almost identical with that of the Hattersley.

The Fraser machine is the third and last of the guide-plate composing machines of the present day which need to be noticed. It has a strong family likeness to the Hattersley, of which its inventor claims it is an improvement. The types are kept in grooved trays, formerly nearly horizontal, but now vertical, as in the Kastenbein. The grooved guide-plate, the composing-stick, the metal pushers which push the types into the grooves down the conducting plate, and the modes of actuating them are like Hattersley's. The guide-plate is grooved in the same way, but each groove is wider and a little deeper. The glass in front

may fit close or may be removed from it several distances, and it is by means of this alteration of the glass and the width of the grooves that different sizes of type may be set up by the same machine. The mode of touching the keys is much the same as in the Hattersley.

If the Fraser composer is like that of Hattersley, the Fraser distributor is like that of the original Kastenbein distributor. The matter to be distributed is placed on a small fixed table and several lines of it ranged to make one long line. There is an aperture leading to the guide-plate below, and a pusher shoots the type on its downward journey to the grooved type trays. The types have all to start from one point, and before reaching the trays have to be separated into nearly a hundred different compartments, by switches similar in principle to those of a railway. Nearly all kinds of type in ordinary use can be distributed by one machine. The touch is heavier than that of the composer, and the progress is necessarily slow.

I ought to mention that last night I received a letter from a gentleman at Bolton—Mr. R. Winder—relative to a composing machine and a distributing machine which he says he is now working. I have not seen these machines, and do not know if they are working anywhere else than at the office of their inventor. There are photographs of them on the table. Mr. Winder says that "the young lady at the composing machine works with both hands into a stick placed on the ledge below which has a V mouth. She composes and justifies at the rate of 3,000 to 3,200 an hour. The distributing machine distributes automatically 8,500 to 9,000 an hour." As I have said, I know nothing about the machine. Proofs have been sent me, too, from type set up by it. They are also here shown. Printers will notice the abundance of battered letters they display. If it is a practical machine it is a pity its inventor has not taken the usual means to bring it before the printing fraternity.

I come at length to the Thorne combined type-setting and distributing machine, which will require a more detailed description than the machines already noticed, because it embodies the principle which essentially actuates machinery, giving the most satisfactory results, and which, in my opinion, must supersede all other systems employed in type-setting mechanisms.

The Thorne combines in one apparatus two distinct machines—the type-setting and the type-distributing machines. There is the ordinary key-board, with cornet-like keys. Behind this are two large vertical cylinders having the same axis, the upper cylinder revolving upon a collar, though seemingly resting on the lower one. The upper one is the distributing portion, and the lower corresponds to the ordinary type-case. The types in each are contained in ninety vertical grooves or channels, the width being slightly greater than the breadth or body of the types, which lie on their sides with their faces slightly projecting. The keys on the key-board correspond in number to the grooves.

The lower cylinder is stationary. The machine being in operation, whenever a key is lightly touched the mechanism causes the ejection from its proper groove of the corresponding type. This is received on a rapidly revolving circular disc, and with the same axis as the cylinder, but with a larger diameter. A number of types may be ejected simultaneously from the grooves on to the disc and are brought round in their proper order to a point of delivery. It is this possibility of ejecting the types on to the rotating disc as fast as the keys can be depressed that enables the apparatus to run at an extraordinary speed, giving quite double the capacity of any of the guide-plate machines. From the point of delivery of the revolving table, the types are conveyed by a carrying belt and fed by a packer capable of lifting over 20,000 types per hour continuously to a setting-

stick, and thence to a galley. Here the justifying is done by an operator who sits opposite a small case containing spaces, quads, and having at command mechanical appliances to greatly expedite his work.

Such is an outline of the arrangements of the composing part of the machine. The upper cylinder, which rotates with an intermittent step by step motion, is the distributing part. Like the twin cylinder underneath, it is cut with ninety grooves. A galley containing the type for distribution is by a suitable attachment fixed at the side of the cylinder, and the lines of type are bodily fed into the grooves of the top cylinder indiscriminately, the type being ordinary dis., and of course in no way assorted. This is continued until the vertical grooves are full of matter. Meanwhile the distribution has begun into the grooves of the cylinder below, the "a's" all in one, the "b's" in another, the "c's" in another, and so on. This operation, being automatic, is infallible. The types themselves are "nicked," as already explained, a different location and proportion of groove being made into the body of each letter. The grooves in the lower cylinder are provided with projections, corresponding to the grooves or nicks in the side of the types, like the wards of a lock and its key, and thus excluding from a groove all but the type or character belonging to it. The upper cylinder, as it revolves upon the lower one, halts momentarily as each and every channel coincides with those in the lower cylinder. As the grooves containing the portion of mixed type pass over the mouths of the shaped grooves of the lower cylinder, letter after letter is shot into its appropriate groove. Thus the type is automatically distributed at the rate of 20,000 to 30,000 per hour, and can be done either simultaneously with composition or independently at will.

One combined machine is worked by three operators one man who sets the type, another who justifies it, and a

boy who fills the grooves with type. The latter may supply two machines. The speed at which type can be set up and justified (and of course supplied with type simultaneously) is most remarkable. I myself have seen at the rate of over 12,000 ens per hour done by an expert. Ten thousand per hour is no extraordinary performance after some practice. I am anxious not to exaggerate, as the inexcusable exaggeration of some inventors of machines have both disappointed purchasers and militated greatly against the introduction of type-setting machines generally. So let us see how the thing works out on a very moderate basis so far as the Thorne machine is concerned.

We will take the highest paid labour in the kingdom, that of London, the "stab" wages of a compositor being 36s. We will also take a minimum of speed, not of 10,000 or even 8,000, but 6,000 per hour, which, at forty-eight hours only per week, means 288,000. The cost of the two operators, at 36s. each, is 72s.; of the distributing boy, say, 10s.; total, 82s. A simple sum in division will show that this brings composition and distributing, that is type-setting, justifying, and distributing, at a fraction under $3\frac{1}{2}$d. per 1,000. Suppose a halfpenny, which is ample, is added for correction, then the entire cost is under 4d. per 1,000. Now let us see what the recognised London union piece rates are for bookwork: Long primer, 7d. (manuscript); bourgeois, 7d.; brevier, 7d.; minion, $7\frac{1}{4}$d.; nonpareil, 8d.; ruby, $8\frac{1}{2}$d.; total, 3s. $8\frac{3}{4}$d. One thousand of each of these six bodies would cost 3s. $8\frac{3}{4}$d. The machine sets with equal facility large and small bodies. The cost of 6,000 ens would by machine be under 2s. Put it another way: A nonpariel 8vo. edition of the authorised version of the Bible runs to just 1,000 pages. I leave out marginal notes and find that each column is 10 ems pica wide or 20 across. This is 40 ens pica, or 80 ens. The pages are about 41 ems deep, or 82 lines. $82 \times 80 = 6{,}560$ as the contents of one page, or

6,560,000 of the book. This 6,560,000 would cost for setting up a reprint, according to scale, £191 6s. 8d.; by machine, £95 9s.—a saving of £95 17s. 8d. Let us now look at newswork. A minion column of the *Daily News*, 16 ems pica wide, containing 250 lines, runs to 13,500 minion ens, which, at the established rate of 9d. per 1000, would amount to 10s. 1½d. If set up by machine, it would cost about 4s. 6d. If only one page of six columns were set up mechanically every day the saving for a year would exceed £500.

In short, a single Thorne machine is the concentration of from six to twelve hand-cases, differing, however, in this, that to start composition it contains only about 30lbs. of type in compact order, instead of some 300lbs. to 500lbs. heaped up in the small divisions of the six or more ordinary hand cases. It has conclusively proved its capability to meet all the stern requirements of both morning and evening newspapers, doing short "takes" as well as long takes with celerity and profit. Its work is so clean that frequently newspaper matter is sent direct from the machine to the press without reading, and for bookwork no hand compositor can possibly excel it in any way.

A machine possessing such practical and profitable capabilities certainly realises a desideratum sought after for very many years. It has solved the problem of setting and distributing type by mechanical means in a highly satisfactory way, for it has long since passed the experimental stage, is now undoubtedly an accomplished fact, and enterprising newspaper and book publishers will not be slow to recognise that the services of such a machine is as essential to the well-being of their business as is the rotary press.

I hold in my hand proofs of galleys of matter set up by one Thorne machine in the office of the *Bradford Observer*, May 1st, 1890, in seven hours and thirty-three minutes consecutive running time the average per hour being over

ten thousand ens, or over three lines per minute, 52 ens minion, composed and justified, distribution going on simultaneously. The operator and distributor lad have had about two years' experience, and the justifier about twelve months. The type broken by the machine in producing 78,186 ens was under 6½ ounces. These proofs will be laid on the table for inspection at the close of this meeting.

I may here mention that I applied to all the vendors of composing machines for certain information as to speed, with the exception of *The Times*. The reason why I excepted the Kastenbein machine was that *The Times* proprietary make their own machines and do not offer them to the trade. To my application I received only two replies. One was from the Linotype Company conveying information already given to you. The other was from Mr. Fraser, who declines to give figures, but says it is not the speed but the other pros and cons that will decide which is the preferable machine. The makers of the Hattersley and the Lagerman machines have not replied at all. Their silence is significant. I would have been glad if they had given me some opportunity of verifying—as I have done in the case of the Thorne—the claims made in their several circulars. I understand, with regard to the Hattersley, that it takes several years for above-average men to acquire the ability to produce one-half what can be produced on the Thorne by men of average ability within eighteen months. There is no instance wherein operatives having continuous experience of the Thorne for eighteen months have failed to develop the ability to produce 10,000 ens per hour. The greater the facility with which any machine is acquired, the more valuable it is in many respects. Another point to which I would particularly ask your attention is, that above-average ability men are both difficult to get, and difficult to keep. This really deserves more consideration than time will now permit me to devote to it.

The type-setting of the future—that is, of the class of book-work and news-work to which, of course, I am confining myself will, I venture to predict, be done on machines of the rotary principle. Just as the cylinder and rotary principle in press work has superseded the platen method, so the rotary machine will be the ruling machine in the machine-composing room. For nearly 400 years press-work was done on the hand press. Two men were required, working very hard indeed, to "perfect," or print on both sides of the sheet, at a rate of about 100 per hour. Then Koenig brought out his cylindrical machines, and at one bound raised the possible production tenfold—to 1,000 per hour. This has been raised since to 10,000 per hour, and even more. A similar revolution is about to take place in the composing-room. Instead of the man lifting 1,200 stamps per hour, we shall see him sitting before a rotary machine that manipulates 12,000 per hour.

The invention of the rotary press was the greatest event in the typographical annals of the first quarter of the nineteenth century. The invention and introduction of the rotary type-composing machine is the great event of the last quarter of the century. It triumphantly crowns an edifice of progress in the graphic arts unexcelled in interest, in brilliancy, in importance, in usefulness, by the progress accomplished in any other sphere of industry, or in any department of human ingenuity.

APPENDIX.

On page 46 of this reprint of my Paper, I state that I myself have seen at the rate of over 12,000 ens per hour composed by an expert. As this statement attracted considerable attention, it may be desirable to give further particulars of a trial test made at my own instance.

I had heard of extraordinary achievements claimed for the Thorne machine, some of which appeared to me almost incredible ; but was curious to watch the machine under conditions such as it would require to sustain under the wear and tear, the high pressure speed, the fearful exactions under which work on a great morning newspaper must necessarily be carried on. There were several Thorne machines, I learned, at the *Guardian* office, Manchester, where are also printed the *Manchester Evening News* and the *Manchester City News*. To Manchester accordingly I made my way last December, quite unaccompanied. I spent in watching the machines parts of five days ; dropping in, unexpectedly, at odd times, day and night. In this way only, I considered, could a fair idea be obtained of the actual everyday working of the apparatus. I did not want show-room or exhibition performances.

I arranged what I considered a crucial test –one, in fact, to which I was told beforehand those interested in the machine would not submit. I took out of my pocket, without previous intimation to the operators of my intention, a galley proof of matter, which no one had seen, and required a portion of it to be set up before my eyes. I was to carefully note the time occupied, and then immediately carry off the matter composed. The object of this was not only to know exactly the quantity set in the specified time, but the quality ; for it is as possible to make a great show with a machine, and do little real work, as it is possible for the hand compositor, with his false motions, to impress the onlooker with the appearance of doing something prodigious. Further, I wanted to see if the justifying was sufficiently good for newspaper work, having heard that in some machines the justifying was so imperfect that it had to be done over again by hand. I accordingly gave out the copy, and when it was completed, the matter was tied up, and several proofs pulled under my own eyes, for the satisfaction of all concerned, papered, and immediately carried

away to my hotel. There could be no tampering with the matter, either in regard to correcting or re-spacing. Here is an impression from an electro taken of the type exactly as it came from Manchester.

THE ECONOMICS OF COMPOSING MACHINERY.

Mr. Theo. L. De Vinne, the eminent New York printer, has written the following thoughtful and far-seeing paper on one of the most important questions of the present day, for the *National Publisher and Printer*, St. Louis:—

"There seems to be an uneasy feeling among compositors about type-setting machines. It is true that only three of the many recently invented are at practical work, but all of them give a promise of usefulness, if not in all fields, at least in some field of composition. It is certain that the machines have come to stay. Compositors fear that they will reduce the price of labour, and will indirectly drive them out of business.

"Much of this disquietude is unnecessary. That type-setting machines may or will reduce the cost of the work on reprints and cheap books and papers is probabe; that it will ever drive any large body of good workmen out of business is absurd. The machines will surely make more work for workmen. So far from decreasing the standard of workmanship, they will elevate it. This conclusion is warranted by a review of the changes in the trade made by inventions in another department—that of press-work.

"Fifty years ago the advantages of machinery in presswork were recognised in this country, but they were not fairly tried. Stereotype, composition rollers, cylinder presses, and Adam presses had then been invented, but were little used. The New York *Sun* and New York *Herald* were trying to print growing editions of their then petty sheets on hand presses. Harper and Brothers, and other book printers in New York, were doing their presswork on hand presses. Books were cheap and editions were small; pre smen were abundaant and wages were low. Journeymen piece compositors were paid an average of twenty-four cents per thousand ems, and earned seven dollars a week with difficulty. Weekly wages for time compositors were nine dollars, but this sum was earned only by the more active and expert. The average wages of piece compositors, and occasional time hands, was not over seven dollars a week. Hand pressmen, paid almost entirely by the piece, had to do an amount of hard labour to earn nine dollars a week, which the modern power pressmen would regard as excessive and unreasonable.

"Although work was hard and wages small, there was even then a dislike to machinery—a dislike which seems to have been imported from abroad. Johnson, an eminent printer of London, had already denounced the printing machine, then in use as London, as the destroyer of the living pressmen, and called upon Parliament to impose a tax on machine perswork, so that machines could not work for a lower price than hand presses. In 1830, and even as late as 1848, the journeymen printers of Paris destroyed printing machines in the Royal Printing Office of that city, as well as in other offices, because they said that these machines were taking the bread out of their mouths. Stereotyping, invented by Ged in the last century, had been delayed more than fifty years by the opposition of hand pressmen, who secretly battered plates in the supposed interest of compositors. Master printers were afraid to use the new process. Composition-rollers were opposed by pressmen, because they enabled a boy to do the work of the exrta man, who wielded the old-fashioned inking balls. The first inking machine attachment was found more objectionable, because it enabled the master printer to

dispense with this extra roller boy or this extra man, who had been regarded as necessary to the working of the hand press. Every invention or process that increased production was regarded by working men as an evil agency.

"In this country there has never been any active hostility to new machinery in the printing business. There have been no mobs or strikes against inventions, but workmen look on all new devices with supsicion and unfriendliness. They do not see that the invention which temporarily throws one man out of work ultimately makes work for two or more men.

"What would have been the state of the trade if we had no stereotype or electrotype, no composition-rollers, and no printing machines? The daily newspaper, as we now have it, would be an impossibility. An edition of two thousand or twenty-five hundred copies of a small sheet would be the highest performance of the hand press, and what severe work this paltry performance would impose on the wretched hand pressmen who had to print this edition in a hurry. The illustrated magazine of large edition and low price, filled with fine woodcuts, could not exist at all in days of hand presses. One could go on and show how hand presses would curtail the production not only of the popular, but of the artistic forms of typography.

"Processes and machines that were once dreaded are now used by every printer, and they are welcomed as much by the journeyman as the master. No one will pretend that they have reduced the number of workmen. Where there was one printer fifty years ago there are at least twenty printers now. Instead of driving hand pressmen out of the trade, the printing machines have really brought more pressmen in it, and have enabled an employer to pay them better wages. The machines have not even driven good hand pressmen out. In all our large cities the expert hand pressman is in active demand. He does but one-half the labour of his predecessor, yet he is paid twice as much and has steadier work. For some forms of printing the hand press is more economical than any machine, and if there were more men who could use them skilfully they would be more generally employed. They are not used because it is difficult for an employer to get a boy to learn this branch of presswork. He objects, because the work is hard. Not even for double or treble the old pay will a pressman in 1889 undertake to do on a hand press the work done by all pressmen in 1840.

First as to *speed*. This piece of composition was set up in thirty-eight minutes. The type is minion, the measure 19 ems pica, which is equivalent to 32 ems minion, or 64 ens minion. There were set up 100 lines, which makes the number of ens minion in the piece 6,400. Hence as 38 minutes, time occupied, is to 60 minutes, so is 6,400 to x (the number of ens per hour). This gives 10,105 per hour. The operators were the youth, Thomas Horgan, who attends to the distributor, which is entirely automatic; Mr. H. J. S. Mackay, who did the composing—he had been at the machine for about eighteen months; and Mr. W. Lowther, justifier, who had been on the machine less than six months.*

* Justifying and composing went on simultaneously; the justifier at the close of the test trial, being slightly in advance of the composer.

Secondly as to *correctness*. This matter, as already stated, is printed exactly as it came from the machine. It has not in any way been corrected or revised. The reader can judge for himself the quality of the composition in regard to correctness.

As the few somewhat worn letters in the above matter may be thought to be attributable to the machine, it was deemed desirable to have it re-set in smaller type to prove the contrary. The following is a letterpress impression of the result in nonpareil, uncorrected, and just as it came from the machine.

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Careful note was taken of the exact time occupied in setting and justifying the above, distribution going on simultaneously.

The machine was started at	11 40.
The compositor finished at	12 12.
The justifier finished at	12 15½.

Showing 35½ minutes from the moment of starting the machine to lifting the galley, but the actual time occupied by the compositor was only 32 minutes. This gives an output capacity of the Thorne machine of 12,640 ems per hour, and a demonstration of such output capacity can be seen by any one obtaining the requisite privilege from Messrs. Taylor, Garnett & Co., proprietors of the *Manchester Guardian*, in whose office the above work was done.

This remarkable result, it will be seen by the practical printer, was achieved in working small type. Hereby is suggested a subsidiary, but by no means unimportant, advantage presented by the machine; in view of the fact that the smaller the type the higher the rate which is paid for it in hand composition.

In further confirmation of my statement with regard to the speed of the Thorne Machine, the eminent firm of printers at Bradford, Messrs. Byles, proprietors of the *Bradford Observer,* have supplied me with the following record of running of Thorne Machine No. 81 in their office:—

SUMMARY OF RESULTS.

APRIL 28TH, 1890 (first day):	
Time machine ran	7hrs. 30min.
Product in lines	1,266
Product in "ens" minion	65,832
Average per hour	8,780
Type broken	13 oz.
APRIL 29TH (second day):	
Time machine ran	6hrs. 35min.
Product in lines	1,275
Product in "ens" minion	66,300
Average per hour	10,171
Type broken	7 oz.
APRIL 30TH (third day):	
Time machine ran	2hrs. 51min.
Product in lines	486
Product in "ens" minion	30,992
Average per hour	10,875
Type broken	5 oz.
MAY 1ST (fourth day):	
Time machine ran	7hrs. 33min.
Product in lines	1,467
Product in "ens" minion	76,284
Average per hour	10,104
Type broken	6 oz.

An insufficient quantity of available type was the reason which prevented the operatives putting in full running time daily. The machine itself was always ready to respond to the touch of the operator.

It will be seen that the 239,408 minion ens were composed and justified, distribution going on simultaneously, in the 24½ hours' running

time. This schedule is interesting in another way than as a demonstration of speed. It will be noticed that the quantity of type broken was very carefully weighed. The result is that the 239,408 minion ens, which, in other words, constitute 4,604 lines of a 26-em newspaper, were set with a breakage of only 31 oz. The saving in cost of production of these 239 thousands I reckon at about 5d. per thousand, or £4 19s. 7d.; the cost of the type broken would be less than 3s.

I was asked at the close of the paper as to the time ordinarily required to become efficient at the machine, and have learned that workmen of average ability usually acquire the facility to turn out at the rate of at least 6,000 ens per hour within the first two months of their regular operation of the Thorne machine, and thereafter, according to effort and application, to upwards of 12,000 ens per hour, there being, as already stated, no instance of operatives having eighteen months' continuous experience failing to develop the capacity to produce over 10,000 ens per hour.

I may perhaps add that I am not a member of the Syndicate who own the patents of the Thorne machine, and have no monetary interest in it in any way. I can, therefore, express an entirely impartial and independent opinion upon it, as upon other composing machines.

London, November 15th, 1890.